

WE CLAIM:

1           1.    A method of generating ultraviolet light,  
2   comprising the steps of:  
3           tuning a neodymium-doped yttrium aluminum garnet  
4   crystal laser to output a first fundamental beam at  
5   approximately 946 nanometers;  
6           doubling the frequency of the first fundamental  
7   beam to produce a second harmonic beam having a wavelength  
8   of approximately 473 nanometers; and  
9           producing a fourth harmonic beam having a  
10   wavelength of approximately 236.5 nanometers by doubling the  
11   frequency of the second harmonic beam using a first cesium  
12   lithium borate crystal oriented for non-critical phase-  
13   matching.

1           2.    The method of claim 1, further comprising the  
2   step of cooling the first cesium lithium borate crystal to  
3   between -10 degrees centigrade and -20 degrees centigrade.

1           3.    The method of claim 1, further comprising the  
2   step of disposing the first cesium lithium borate crystal in  
3   a container of dry inert gas.

1           4.    The method of claim 1, further comprising the  
2   step of disposing the first cesium lithium borate crystal in  
3   a vacuum.

1           5.    The method of claim 1, further comprising the  
2   step of confocal focusing of the second harmonic beam into  
3   the first cesium lithium borate crystal.

1           6.    The method of claim 1, further comprising the  
2   steps of:

3 tuning a rare earth doped garnet laser to emit a  
4 second fundamental beam at a wavelength of approximately  
5 1077 nanometers;

6 directing the second fundamental beam and the  
7 fourth harmonic beam to a second cesium lithium borate  
8 crystal; and

9 sum-frequency mixing the second fundamental beam  
10 and the fourth harmonic beam in the second cesium lithium  
11 borate crystal to produce an output beam at approximately  
12 194 nanometers.

1 7. The method of claim 3, wherein the dry inert  
2 gas is selected from the group consisting of nitrogen, dry  
3 air, helium, neon, argon, krypton and xenon.

1 8. An apparatus for generating ultraviolet  
2 light, comprising:

3 means for tuning a neodymium-doped yttrium  
4 aluminum garnet crystal to output a first fundamental beam  
5 at approximately 946 nanometers;

6 means for doubling the frequency of the  
7 fundamental beam to produce a second harmonic beam having a  
8 wavelength of approximately 473 nanometers; and

9 means for producing a fourth harmonic beam having  
10 a wavelength of approximately 236.5 nanometers by doubling  
11 the frequency of the second harmonic beam using a first  
12 cesium lithium borate crystal oriented for non-critical  
13 phase-matching.

1 9. The apparatus of claim 8, further comprising  
2 means for cooling the first cesium lithium borate crystal to  
3 between -10 degrees centigrade and -20 degrees centigrade.

1           10. The apparatus of claim 8, further comprising  
2 means for disposing the first cesium lithium borate crystal  
3 in dry inert gas.

1           11. The apparatus of claim 8, further comprising  
2 means for disposing the first cesium lithium borate crystal  
3 in a vacuum.

1           12. The apparatus of claim 8, further comprising  
2 means for confocal focusing of the second harmonic beam into  
3 the first cesium lithium borate crystal.

1           13. The apparatus of claim 8, further comprising:  
2 means for emitting a second fundamental beam at a  
3 wavelength of approximately 1077 nanometers;

4 means for directing the second fundamental beam  
5 and the fourth harmonic beam to a second cesium lithium  
6 borate crystal; and

7 means for tuning the second cesium lithium borate  
8 crystal to sum-frequency mix the second fundamental beam and  
9 the fourth harmonic beam to produce an output beam at  
10 approximately 194 nanometers.

1           14. The apparatus of claim 10, wherein the dry  
2 inert gas is selected from the group consisting of nitrogen,  
3 dry air, helium, neon, argon, krypton and xenon.

1           15. An apparatus for generating ultraviolet  
2 light, comprising:

3 an active laser medium comprising a garnet crystal  
4 doped with a rare earth element;

5 a diode pump laser for pumping the active laser  
6 medium;

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7 a resonator for generating a fundamental beam  
8 having a wavelength of approximately 946 nanometers from the  
9 pumped active laser medium;  
10 a periodically-poled potassium titanyl phosphate  
11 crystal for producing a second harmonic beam having a  
12 wavelength of approximately 473 nanometers; and  
13 a cesium lithium borate crystal cooled to a  
14 temperature in the range from -10° centigrade to -20°  
15 centigrade and oriented for non-critical phase-matching, for  
16 producing a fourth harmonic beam having a wavelength of  
17 approximately 237 nanometers.

1 16. The apparatus of claim 15, wherein the active  
2 laser medium comprises a neodymium-doped yttrium aluminum  
3 garnet crystal.

1 17. The apparatus of claim 16, wherein the  
2 neodymium-doped yttrium aluminum garnet crystal comprises a  
3 first un-doped end portion, a doped central portion and a  
4 second un-doped end portion.

1 18. An apparatus for generating ultraviolet  
2 light, comprising:

3 an Nd:LiYF<sub>4</sub> laser tuned to output a fifth harmonic  
4 beam at approximately 209 nanometers;

5 a garnet laser doped with a rare earth element and  
6 tuned to output a fundamental beam at approximately 1305  
7 nanometers; and

8 a cesium lithium borate crystal for sum-frequency  
9 mixing the fundamental beam and the fifth harmonic beam to  
10 produce an output beam at approximately 180 nanometers.